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ABSTRACT

A study of schools was conducted to determine needs of earth science programs, and what, if any, services could effectively be provided by an earth science resource center. Contacts were made with approximately one-half the schools in the Minot State College service region. Discussions were held with administrators and teachers, and facilities at each school were evaluated. A resource center offered experimental programs to determine types of services earth science teachers really use. As each program was offered, notation was made of the types of schools and teachers using it, and of the impact on earth science classes. Results indicate: earth science programs lack equipment, however, rich resources are available from other science programs; funds for earth science resources seem to be available; teachers generally lack training in earth science, but have substantial background in other sciences; there is a strong demand for in-service offerings in earth science, and also for regular seminars and lecture series on earth science designed for teachers; workshops are popular, but appear to have little impact; teachers having regular contact with the resource center will take advantage of opportunities to borrow equipment; and serious interest in trading specimens appears to be lacking. (Author/PR)

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Final Report

Project No. O-F-032
Grant Number OEG-6-70-0019 (509)

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"RESOURCES AVAILABLE FOR EARTH SCIENCE EDUCATION"

July, 1971

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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A study of schools has been conducted to determine needs of earth science programs, and what, if any, services could effectively be provided by an earth science resource center. The study involved contacts with approximately one-half the schools in the Minot State College service region, discussions with administrators and teachers, and an evaluation of facilities at each school. A resource center offered experimental programs to determine types of services earth science teachers really use. As each program was offered notation was made of the types of schools and teachers using it, and of the impact on earth science classes.

Results indicate earth science programs lack equipment, however, rich resources are available from other science programs. Funds for earth science resources seem to be available. Teachers generally lack training in earth science, however, have substantial background in other sciences. There is a strong demand for in-service offerings in earth science, and also for regular seminars and lecture series on earth science designed for teachers. Workshops are popular, but appear to have little impact. Teachers having regular contact with the resource center will take advantage of opportunities to borrow equipment. Serious interest in trading specimens appears to be nil.

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Resources Available for Earth Science Education (North Dakota)

Dr. Eric Clausen

Minot State College

Minot, North Dakota 58701

July 1, 1971

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of Education

Regional Research Program

PREFACE

Too often we hear statements about the crisis in earth science education. A 1965 survey (Shea, 1966) concluded that only 14% of those teaching earth science had majored in earth science, only 26% could meet basic certification requirements, and that only one teacher in five took students in the field. At meetings of the National Association of Geology Teachers frequent pleas have been heard for the improvement of earth science teaching. The American Geological Institute is continually predicting shortages of earth science teachers. (Henderson, 1967, 1969).

North Dakota, which made earth science an eighth grade requirement in 1963, has provided no exception in the cries for improvement. Reith, 1969, concludes that in North Dakota earth science "teachers generally have little or no formal earth science education. The facilities, laboratory space, and equipment are insufficient. And, the programs do not even begin to approach the objectives outlined by the state." Reith's conclusions are strongly seconded by Foster, 1971, in his report on the earth science curriculum in the Missouri Slope. This writer also joined in the criticism of earth science programs in North Dakota (proposal for this project). Yet all of these critics viewed the crisis from the protection of an institution of higher learning.

The only way to really get to know what is happening in earth science education in North Dakota is to visit the schools, work with the teachers and administrators in trying to solve their problems, and just listen to everyone connected with earth science education. For a full year this project director visited schools with the message that any reasonable help he could provide would be forthcoming. The results, while placing heavy demands on the person of the project director, were not as anticipated. Earth science in North Dakota is secure. True there are many

schools offering earth science with substandard facilities, there are many teachers teaching earth science without training in the subject, and there are many students who are bored with their earth science classes. But the statistics fail to show the pride of most communities in their schools, the desire of teachers to do their best, and the excitment of students for more earth science. The sudden emergence of earth science into the curriculum of North Dakota schools was bound to create a crisis. However, the job of correcting this bad situation is well underway.

Perhaps more significant than the data which follows concerning this project was the impact of the experiment on attitudes of school administrators and teachers. At many schools the project director was the first person to ever visit specifically about the earth science program. Superintendents were anxious to know what could be done in earth science, and how their school could do it. The fact that someone cared enough about the subject to visit their classrooms almost certainly had an effect on teachers. While statistics were not kept of equipment purchases, I strongly suspect that more laboratory equipment was purchased for earth science this last year than in the previous ten years combined, that teachers conducted more field trips than in the past, and that in general earth science classes were more exciting than in previous years. If this project helped in any way in achieving this improvement, I am certain that it can be considered a success. My sincere thanks are extended to the Regional Research Program of the Office of Education, to the administration of Minot State College, and to the countless individuals who assisted in this study for the help which was provided.

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INTRODUCTION

Earth Science has been a required 8th grade subject since 1962 in North Dakota. In addition, a number of districts are also offering advanced courses in Geology and Astronomy. However, as of 1968, not one North Dakota college or university had graduated a student with a degree in earth science education. Persons teaching earth science in North Dakota were trained as biologists, chemists, or social scientists (including geography). Several had the benefit of National Science Foundation supported institutes at the University of North Dakota, although most had only token training in Astronomy, Geology, and Meteorology (1969, Howard Reith, unpublished Ph.D. thesis, University of North Dakota). Teachers trained in disciplines other than the earth sciences were, according to Reith, seldom able to realize the advantages of various laboratory resources and teaching aids available. Consequently, laboratory work in most earth science classes was assumed to be weak at best.

Minot State College agreed in 1968, at the request of the National Association of Geology Teachers, to become a resource center in an effort to provide emergency support to local earth science teachers. Activities of the resource center prior to this project included:

1. loans of various laboratory materials, color slides, books, etc. to area schools
2. visits to area schools by college faculty
3. open houses for school groups in the college observatory, housing a 16" Schimidt-Cassegrainain telescope
4. six public field trips in Northwestern North Dakota

5. several lecturers at the college campus selected for interest to local teachers

6. coordinating two conferences at Minot State College for area teachers under auspices of the National Science Teacher's Association

7. publication of a short newsletter

8. a number of other miscellaneous services

Support for this resource center prior to this project came from a number of sources. These include:

1. time donated by Minot State College faculty members

2. two small unrestricted grants received from the Great Northern Railroad Foundation

3. secretarial services, most items used for loans, general supplies, use of facilities, and some travel funds were provided by the college

4. support from the National Science Teachers Association and North Dakota Education Association and related groups in planning conferences on the Minot State College campus

The college had also allied itself with seven public school districts and one private school in a Cooperative College-School Science Project in Earth Science (National Science Foundation, Cooperative College School Science Project which ran concurrently with this project).

Response to the resource center prior to 1970 had been limited. Almost 80% of the 142 schools informed of the availability of the resource center failed to indicate an interest. Follow-up studies indicated that major factors in the nonresponse might be:

1. Local earth science teachers were so completely "unprepared" that they were unable to make use of services being offered free of charge.

2. The activities of the resource center were not geared to meet real needs of the local earth science teachers.

3. Persons teaching earth science in central and western North Dakota were devoting their major efforts to their area of training, neglecting their earth science teaching committments.

4. The exceptionally high turnover of earth science teachers in most school districts in the Minot region.

It appeared then that the Minot State College resource center reached only those districts with moderately strong earth science programs. Most of the weakest schools for which the resource center was designed were not being assisted through the program.

Therefore, the immediate objectives of this project were:

1. to determine the type of activities for an earth science resource center which meets the needs of local schools

2. to adjust the activities of the resource center to insure that the schools actually needing the services take advantage of the services

3. to encourage the establishment of other resource centers at other colleges and universities by illustrating in the Journal of Geological Education the experiences of Minot State College

The activities of this project were centered around:

1. an evaluation of resources presently available to earth science teachers

2. an evaluation of a number of new experimental programs operated by the College Resource Center. These experimental programs included:

    (a) workshops on laboratory investigations

    (b) field trip guide books (mineographed) made available to local earth science teachers

    (c) a rock, mineral, fossil, and color slide exchange center for earth science teachers and students

    (d) visits to schools by college science students acting as laboratory assistants and teacher aides

    (e) a lecture series on the geology of North Dakota

METHODS: RESOURCE INVENTORY

To begin, it was necessary to obtain an accurate evaluation of the resources available to earth science teachers within their own school districts. The eighth grade in which earth science is taught may be included in (a) elementary schools, (b) middle or junior high schools, or (c) senior high schools. A sample of 40 schools in the College service area permitted evaluation of resources as follows:

1. The project director personally visited all schools in the sample during the summer of 1970 to meet the superintendent or principal and to prepare a detailed list of resources available to earth science teachers. The personal visit with the superintendent provided the following:

   (a) acquainted the superintendent with the project and obtained his support for future visits

   (b) determined the earth science teacher's work load and other responsibilities

   (c) obtained a copy of the earth science teachers transcript (as relating to science)

   (d) determined budget, if any, available for earth science laboratory facilities

   (e) determined ability of school to offer field trips, night labs for Astronomy, etc.

The detailed list of resources prepared by the project director provided the following information:

(a) Fixed facilities in classrooms and laboratories such as water, drains, gas, electrical outlets, lab-demonstration tables, bulletin boards, stockrooms, etc.

(b) Other permanent equipment such as microscopes, audio-visual equipment, telescopes, maps, rocks, minerals, fossils, etc.

(c) Short field trip possibilities in the immediate vicinity of the school (i.e. stream runs through playground, glacial erratics on front lawn, weathering of building stones).

The information obtained during this evaluation was placed on file under the name of the school and was used for the following purposes:

(a) Compared with data on hand concerning resources which was earlier obtained from earth science teachers by mail questionaires.

(b) Assisted the project director in mailing suggestions to local earth science teachers regarding resources already available.

(c) Determined needs for such activities as

1. Loans of lab equipment
2. Offering in-service institutes
3. Offering special workshops designed around various equipment

(d) Prevented duplication of resources already available.

(e) Determined what resources the College could assist with.

(f) Determined possibilities for co-op purchasing of specialized equipment by small districts.

The project director visited earth science classes in operation at most of these schools during the academic year to determine how effectively teachers made use of resources they had on hand.

RESULTS OF RESOURCE INVENTORY

In addition to the 40 schools visited, a number of other schools were added during the academic year (list of all schools evaluated is in Appendix 3). Results of this resource inventory were as follows:

First, equipment available for earth science at schools varied from almost nil to surpassing all normal recommendations, including those on this project checklist (Appendix I). However, all schools visited had science lab facilities; most usual biology, chemistry, and physics equipment, including: microscopes, gas for bunsen burners, chemicals, glassware, balances, aquariums, and other similar items. A common situation was to find a school where the earth science equipment consisted of a bucket of unidentified rocks, yet earth science was being offered in, or adjacent to, a well equiped science lab. While specific equipment for earth science is lacking at most schools, a teacher can improvise equipment from the resources available to do almost any type of earth science lab activity.

The school superintendents were all asked if they were prepared to provide additional funds for earth science equipment. Most were apologetic for the lack of specific earth science equipment in their school, and they al stated that they would have spent more money for earth science materials during the preceeding year if the teachers had made requests. Usual figures quoted were that between 20 and 30 dollars per student could have been available if it had been requested. With few exceptions, the superintendents were unaware of any outstanding teacher request for supplies or equipment in earth science.

Another item of equipment available at all but two of the schools visited, yet not included in the initial checklist, were school buses for field trips. School superintendents were especially proud of their flexibility in permitting field trips. Limitations of trip length usually

were the distances that could be traveled in one day. Most teachers willing to drive could have buses on short notice for shorter trips.

Second, the teachers responsible for earth schience classes varied from exceptionally well trained individuals with masters degrees in earth science subjects to individuals teaching on 2-year certificates with no science background at all. Typically teachers lacked substantial training in earth science, although most were well trained in one or more of the other sciences.

Superintendents were eager to support any program which would upgrade the level of preparation of their earth science teachers. Most stated that they had hired "semi-qualified" earth science instructors only because they could not find adequately trained personnel. Superintendents at smaller districts stated the problem of finding individuals qualified to teach all the sciences including earth science.

Superintendents almost demanded in-service and summer programs for their earth science instructors. As a direct result of these requests, made to the resource center, Minot State College offered two extension courses in geology at Harvey, to service teachers in central North Dakota, has set up two summer offerings in environmental science for elementary teachers, prepared a second proposal to the National Science Foundation for a Cooperative College-School Science program in earth science for the 1971-1972 academic year, and prepared a proposal to the National Science Foundation for an in-service institute in earth science for a group of schools in north central North Dakota. All of these programs involved substantial financial committments on the part of the participants and/or the school districts.

Finally the overall attitude of superintendents toward their earth science programs appeared to be good. All were concerened about the

quality of their earth science program and most seemed to be willing to back up their interest with committments of district resources. The major problems uncovered in this phase of the study were (1) lack of training of the teachers in earth science and (2) a lack of agressiveness on the part of earth science teachers in both ordering equipment and supplies and also in utilizing equipment available for other sciences.

Notable exceptions to these findings were the rural school districts administered by county superintendents. These districts either terminate instruction at the eighth grade (busing students to adjacent districts for high school) or operate nonaccredited high schools. In general these districts employ 6 or fewer teachers-many lacking college degrees. These schools lack science facilities and prospects of improvement in facilities appear bleak. Teachers have little or no science training. State requirements forcing non-degree teachers to complete their degrees by 1975 are resulting in many of these teachers obtaining some science training (at most one year of laboratory science). Attitudes of the school boards of these districts do not appear favorable for improvement of science instruction in general-much less in earth science programs. An exception was a county school system where considerable interest has developed in hiring a roving earth science teacher to supplement present offerings in six rural schools.

METHODS: RESOURCE CENTER EXPERIMENT

The second phase of this project was the actual offering of services via the resource center to determine which services teachers would use, and also to determine where possible the impact of these services on earth science classes. Services offered specifically as a result of this project included the following:

Workshops: Earth Science teachers, elementary science teachers, school superintendents, and county superintendents were informed of the availability of workshops on various earth science laboratory teaching techniques. Suggested topics for workshops included: designing a field trip, use of telescopes, use of stream tables, North Dakota geology, etc. Workshops could be arranged either on the Minot State College campus, or at any school or field locality convenient to the participants. No charge was made for the workshop or for any of the supplies used in the workshop. Participants completing the workshop were awarded a certificate of attendence enabling some of them to satisfy state certification requirements.

The availability of these workshops was pointed out to superintendents in the personnal interviews during the summer of 1970, and in two separate mailings to all 142 school districts in the college service area. Mailings to teachers (six different efforts) also emphasized workshops possibilities. Participants at all workshops were invited to request additional workshops to follow up concepts. Teachers were also invited to report to the project director on ideas actually used in their classrooms resulting from the workshop.

Exchange Center: A local rock, mineral, fossil, and color slide exchange center was established to enable teachers and earth science

students to trade materials. The exchange center worked as follows:

1. The resource center obtained without charge a large supply of good quality rocks, minerals, and fossils from a commercial science supply house discontinuing its specimen line. Color slides were duplicated from collections of the project director and those of some 15 earth science students at Minot State College.

2. Lists of additional rocks, minerals, and fossils for trade were obtained from the National Rock and Mineral Exchange Service operated by Charles Wall (McFarland, Wisconsin). These lists were condensed at Minot.

3. Trade lists offering over 500 different types of specimens and over 200 different color slides of geological features were mailed in October to earth science teachers in the Minot State College service region. Instructions with this mailing included the following:

   (a) An offer to trade any item on "our" lists for any specimens regardless of quality

   (b) A post card to be returned if they desired further trade lists

   (c) A swap sheet on which teachers or students could list materials they had for trade.

4. Six additional trade lists were mailed out during the year.

Geology of North Dakota Lecture Series: A series of lectures on the geology of North Dakota were designed specifically for earth science teachers. The lectures were offered on the College campus. All earth science teachers in the college service area were mailed announcements of the lecture series and notices were placed in the newspaper prior to each lecture. The lectures offered as part of this project were:

1. Dr. Eric Clausen - "Badland Formation"

2. Dr. John Reid (Department of Geology, University of North Dakota), "Pleistocene Glaciation of North Dakota"

3. Dr. John Brophy (Department of Natural Sciences, North Dakota State University), "Geological Research at N.D.S.U."

4. Dr. Walter Moore (Department of Geology, University of North Dakota), "Stratigraphy of Western Slope County"

In addition to the lectures offered specifically as part of this project a number of other lectures of interest to earth science teachers were held on campus during the year. These were advertised in the same manner as

the project lectures to regional earth science teachers. These additional lectures included:

1. Dr. Edward Noble (North Dakota State Geologist) "Mineral Exploration in North Dakota"
2. Dr. James McClurg (University of Northern Colorado, Department of Earth Science) "Teaching Techniques in Earth Science"
3. Dr. John Shelton (Science Advisor to Encyclopedia Brittanica Films) "Geology Illustrated"
4. Dr. William Romey (Director of the Earth Science Teacher Preparation Project) "Open Approaches to Teaching Earth Science"

At the conclusion of each lecture earth science teachers in attendance and not known to the project director were invited to remain to become acquainted with members of the earth science department. Notation was made of the total number of earth science teachers in attendance at each meeting. Video-tapes of some of the lectures were offered to schools for showing to earth science classes.

Field Trip Planning Assistance: Field Trip guides were prepared for various regions in the College Service area. These guides included road logs from major population centers to points of local geological interest and discussions of the geology at these points of interest. These guides were then included among the mailings sent out to teachers, distributed at workshops, distributed at in-service courses, made available at the college lecture series, and offered to teachers at the other resource center activities. Teachers were asked to inform the project director of any field trip activity resulting from the project.

Included in this field trip planning assistance were seven public field trips led by the project director to localities of geological interest in the college service area. Also, there were two workshops held on planning field trips (in Benson County and Rollete County) which involved trips.

Teacher Aide Program: This project was revised at the beginning of the academic year to include a program of offering college science students as teacher aides and laboratory instructors in earth science classrooms. Arrangements were made at the college for students to receive credit for these experiences in course work in science education. Students desiring to have such experiences were given names of schools and/or teachers desiring such teacher aides and then made all arrangements on their own. However, prior to visiting the school, the student was required to visit with the project director or another faculty member to demonstrate proficiency in the subjects to be studied. Students had access to all laboratory equipment at the college and could take portable equipment to the schools with them. Most students elected to provide their own transportation to schools, although some made use of college cars and a few took advantage of the project director's offer to provide transportation. Fifteen teacher aides were visited in the schools by this investigator to determine the quality of work done and, where possible, some indication of the impact on the school. Other teacher aides were visited by faculty responsible for the course in which the students were earning credit. Teacher reaction to the program was requested in follow-up comments or letters.

Other Services: In addition to the services offered specifically as part of this project, school administrators and earth science teachers were invited to request any other service which they might desire. Suggestions of services which could be requested included:

1. Loans of college laboratory equipment and other supplies. (This service had been offered for two previous years with few takers.) To increase usage of this service the college purchased in 1970 two complete classroom sets of the Earth Science Curriculum Project laboratory materials. Earth Science teachers were invited by mailings and also at all resource center functions to tour the geology stockroom and borrow equipment. The only limitation placed on loans was that college labs had priority.

2. Open houses at the college for area earth science students. These open houses could include tours of the college science facilities, and/or use of specialized equipment, laboratories, or the college observatory. These open houses were arranged on request.

3. Providing judges for local, regional and state science fairs.

4. Helping to arrange for in-service course offerings for earth science teachers either through the college extension division or various specially funded institutes.

5. Any other service of a reasonable nature which might be requested.

Teachers and school administrators were not informed of any distinction between the above programs (i.e. funded through this project or funded locally). No effort was made to favor any one program over others. The project director kept his schedule free two days of each week to provide those services which were requested. Where schools offered to assist with costs of the services no charge was made to the project (a number of schools offered to pay transportation expenses for the project director when he served as a visiting lecturer, science fair judge, or delivered equipment to schools). Whenever not involved in the offering of requested services, the project director visited earth science classrooms to determine what, if any, impact the experiment was having on teaching styles.

RESULTS OF RESOURCE CENTER EXPERIMENT:

A detailed summary of participation by school districts is given in Appendices II and III. Overall participation in resource center activities by various schools exceeded all expectations of this investigator based on previous experience. The demands placed on this investigator, especially in the area of in-service offering, made it impossible to satisfy some requests for service. Other experimental projects, specifically the exchange center, generated a lot of interest, but had virtually no impact. A description of the reaction to each of the experimental program offering follows:

Workshops: Workshops were requested by county superintendents in Ward, Bottineau, and Rollete Counties. Specific groups of teachers requested workshops in Burleigh, Benson, and Rollete counties (the second Rollette county workshop was held at the request of teachers participating in the county workshop as follow up to the experience). Informal workshops were held with small groups of teachers in specific school districts. Follow up indicated an attempt on the part of some of the workshop participants to include more laboratory and field activities in the earth science programs, but with one known exception--the effects of the workshop were not apparent in teaching methods two weeks after the sessions.

Partially as a result of the efforts of the project director to interest school administrators in workshop activities, some twenty-eight school districts with over six hundred teachers have banded together and requested Minot State College to coordinate a pre-school experience for their teachers. These proposed two-day workshops will be held on the college campus, and will be financed by the participating school districts. The science activities of these proposed workshops will be coordinated by the resource center.

Interest in workshops was high at the beginning of the academic year, however, by November all requests ceased. The requests for workshops next fall indicate that the decline in interest was not a fault of the workshops offered, but that teachers and administrators prefer workshops at the beginning of the school year.

Exchange Center: Interest in the exchange center appeared to be high, causing the project director to place special emphasis on this program. Over two hundred initial trade lists were sent out to earth science teachers in early October, 1970. Ninety teachers responded to this mailing, eighty requesting to receive additional trade lists and indicating a desire to trade. Typical of comments of respondents was "this is a wonderful opportunity, but I have so little to trade."

Actual trading was very limited. Seventeen teachers were involved in trades of color slides, one teacher paid for the cost of duplicating color slides when he had nothing to trade, and fewer than ten actual trades of rocks, minerals and fossils were made locally (three of these were made by earth science students, not teachers). The failure of this program to generate actual trades is puzzling in view of the overwhelming response to the initial trade lists, the mailing of six follow-up trade lists, the high quality of the specimens reserved for local trading, and the prompt response given to those few trade requests which were received. Probably the biggest factor in the negative response to this program was the requirement that teachers offer something in return. Several teachers have mentioned that they will be out collecting specimens this summer in an effort to develop trading stocks, indicating that a one year trial is insufficient for this project.

Geology of North Dakota Lecture Series: Attendance at lectures offered as part of this resource center experiment and other lectures of interest to earth science teachers offered on campus averaged consistently between twenty-five and thirty earth science teachers. Usually twenty of these teachers were participants in an in-service course and were attending on the recommendation of their instructors. Several teachers started bringing senior high school science students to the lectures on a regular basis. Others in attendance at these lectures included townspeople, college students and faculty. Lectures were video-taped and offered to high schools for showing to science classes. Only one request for tapes was received, so the practice was discontinued in the spring.

Teachers in attendance considered the lectures to be excellent, and with occasional exceptions the same group of teachers attended all lectures. Specific impacts on teaching of earth science could not be measured, however, enthusiasum for earth science teaching appeared to increase. Perhaps as important as the lecture presentations were the bull sessions the teachers had with each other and with the college earth science faculty before and after each lecture. Also, teachers attending used the time on campus as an opportunity to borrow lab equipment through the loan program. Several members of the group which attended regularly have requested that the lecture series be continued next year, specifically to provide regional earth science teachers with an opportunity to get to know each other and share ideas.

Field Trip Planning Assistance: The summary of field trip activities shown in Appendix II indicates those schools where the project director is aware of field trips. While information on field trip activities was sent to all schools in the service area and additional information was available

at workshops, public field trips, and in-service programs response to requests for information on field trips was limited. Most of the information obtained is the result of follow-up surveys.

The follow-up did show that at most schools contacted, one or more field trips were being taken and that ideas suggested in resource center guides, workshops, field trips, and in-service programs were being used. The greatest apparent field trip activity was being conducted by teachers in the Cooperative College School Science Project being run by the Earth Science Department for twenty-two local teachers. This C.C.S.S. project offered nearly twenty-five actual days in the field for participating teachers, and these teachers in turn included frequent (five or more) field trips in their earth science programs. Other teachers appeared to average two or three field trips during the academic year.

Teacher Aide Project: The revision of the project to include placement of teacher aides in science classrooms was made at the request of school superintendents during the summer resource inventory. A major effort during the fall of 1970 was devoted to convincing college science faculty that such teacher aide experiences could be worthwhile to science students. College instructors all agreed with the idea, but were unable to translate it into an experience for their students. Consequently, during the fall quarter the requests of schools for this program were only partially filled. The five students who did assist in laboratories during the fall quarter performed well and additional requests came in from the schools which had benefited.

By mid-winter four instructors at the college agreed to participate in the experiment with their students. As a result, approximately twenty-five students worked in various capacities at local schools in assisting with earth science instruction. Normally, students preferred schools in

Minot or nearby towns to save on travel time. Time spent in schools by the college students ranged from daily lab assisting for ten weeks, to working with a single class for one day. Normally the teacher aides spent time observing classes prior to setting up and operating labs on their own. All teacher aides did set up and operate some type of laboratory or field activity.

Response from the host schools was at all times enthusiastic. At every school visited the project director received requests for more teacher aide activity. Usually these requests came from teachers in the same building who did not have a teacher aide, however, all host teachers invited their teacher aides to return any time.

Other Resource Center Programs: The expansion of the resource center activities as stated above resulted in heavier demands being placed on the existing services. The loan program which had generated little interest in previous years was used by over sixty-three teachers. Some of these earth science teachers borrowed items only once, however, many made use of the loan service on a regular basis. Materials being loaned most frequently were the Earth Science Curriculum Project Laboratory sets, and rock, mineral, and fossil kits. Also in demand were topographic maps, geological reports on North Dakota, and filmstrips. Numerous requests were received for films, however, the resource center did not maintain a film library for loaning purposes.

Visits to the college also increased over past years. During 1970-1971 the resource center provided tours for twenty-two different earth science classes or science clubs. Additional tours were provided by other faculty and students at the college. This investigator believes that tour activity arranged outside the resource center increased over previous years, but does not have statistics to support this claim. Teachers were in all

cases enthusiastic about the opportunities to visit the college laboratory facilities and in some cases make use of the equipment. Frequently, prior to tours, earth science teachers would be briefed on the operation of specialized equipment, such as the College's 16" Schmidt-Cassegrainain telescope. Then the teacher would be responsible for the operation of the equipment and instruction while his students were in the lab.

Requests for judges at science fairs doubled over previous years. The increase can be directly attributed to the operation of science fairs by several school districts for the first time. Encouragement of science fair activities in other resource center projects may have played a role in the establishment of these new science fairs.

In-service Programs: Without question the greatest impact of the Resource Center activities was made in the area of in-service offerings. Teacher interest in this type of program was exceptionally high. Forty-two teachers enrolled in a beginning geology course offered in central North Dakota on an extension basis at the request of the superintendent of schools at Harvey, North Dakota. (His request was a direct result of summer resource inventory conducted by this project). Of these forty-two teachers, thirty-eight petitioned for and enrolled in an intermediate level geomorphology course offered at Harvey during the spring. Also offered by Minot State College was a National Science Foundation funded Cooperative College-School Science Project in which eleven school districts and twenty-two earth science teachers participated. Attrition in these in-service programs was less than 5%, indicating the high degree of interest shown in this type of service.

Further evidence of the strong desire for in-service offerings in earth science in central and western North Dakota is that some ten school districts made substantial local committments to insure a second N.S.F. Cooperative program in earth science for the 1971-1972 academic year.

Further, some twenty-five teachers in northcentral North Dakota requested that a similar in-service program be offered in their region and obtained committments from their school districts to use as matching support.

Follow-up on these in-service programs has shown that they not only increase competence in the subject matter, but have also generated teacher enthusiasm for earth science not found in other classrooms and have made major changes in the teaching styles of participating teachers. Lab work, field trips, and individual student projects were much more predominant in classrooms of participating teachers than those of non-participants. Participating teachers also ordered earth science lab equipment, many for the first time. Activity by students of participating teachers in earth science as evidenced by projects at science fairs showed a marked increase over that of other schools.

Services Requested of Resource Center: Several services not anticipated at the commencement of this project had to be provided to earth science teachers during the year as part of the resource center experiment. Most significant of these was the institution of the in-service programs for earth science teachers mentioned above. Also, the project director participated in the establishment of two summer workshops on environmental science which will be offered on the campus by the Extension Division this summer. The resource center also received requests to:

a) help teachers motivate Indian students in earth science classes

b) help design a summer school program for slow learners in earth science

c) assist approximately fifteen earth science teachers in entering graduate programs at various universities.

These requests were handled to the best of the ability of this investigator.

CONCLUSIONS

This project consisted of both an inventory of resources available to earth science teachers in the Minot State College service region and the operation of a number of experimental resource center programs. The following specific conclusions are drawn from this investigation:

1. Specific facilities, laboratory space, and equipment for earth science is lacking in most North Dakota schools. Reith's mail questionaire of 1969 was correct in this interpretation.

2. Facilities, laboratory space, and equipment available for other science disciplines is available at all but the rural non-accredited school districts and is available to earth science classes at least on a part-time basis. These resources have not been noted in mail questionaires which were summarized by Reith, 1969, and Foster, 1971.

3. Persons teaching earth science have poor training in earth science subjects supporting conclusions reached by Reith, 1969, and Foster 1971.

4. Earth Science teachers do have background in one or more of the other science disciplines and most are willing to supplement this training with summer or academic year in-service programs in earth science, provided the earth science training is offered at a convient location.

5. School administrators previous to this project apparently had not taken much initiative in developing resources available to their earth science programs. The apparent willingness of administrators to obtain earth science resources when recommended by this investigator suggests that teachers have also lacked initiative in developing their resources.

6. Contrary to earlier reports, field trips are used in earth science teaching in the Minot State College service region.

7. There is a strong demand for in-service offerings in earth science in the Minot State College service area. Teachers and school administrators are willing to commit their time and finances to insure the offering of such programs.

8. The demand for in-service offerings in other sciences, especially physical science and life science, is also high.

9. The short workshops offered by this project had little impact on teaching of earth science. Most teachers participating in workshops tried ideas immediately following sessions, however, with only two known exceptions, all impact had ceased at the end of two weeks.

10. There is interest in having college functions in earth science designed for earth science teachers (e.g. lecture series). Teachers use these functions as an opportunity to share ideas with each other in addition to the advertised purpose.

11. Serious interest in trading specimens and color slides by earth science teachers in the college service region is apparently nil.

12. The program to loan earth science lab supplies to earth science teachers can generate interest from teachers in contact with the college through other means (e.g. lecture series, in-service offerings). The program apparently will not be used regularly by teachers not in frequent contact with the college.

13. There is strong evidence to suggest that earth science resources available to teachers in the Minot State College service region are improving.

14. Interest by elementary teachers, in a resource center as shown by requests for in-service programs, loans of materials, etc., far exceeds the ability of the Minot State College Earth Science Resource Center to provide these services. No effort was made to solict requests for services from elementary teachers, and these teachers were served on a second priority basis by the center.

RECOMMENDATIONS

The following recommendations are made from this project:

1. Colleges, such as Minot State College, providing resource center activities in earth science should emphasize programs which involve regular contact with earth science teachers. Short workshops and other programs with little or no continuous personal contact do not appear to have any impact on earth science teaching.

2. Programs where earth science teachers are able to meet regularly to share ideas with each other and with college earth science faculty should be developed. Short workshops and other projects not involving regular contact may be successful if viewed as supporting these continuing programs. Colleges in situations similar to Minot State offering serious earth science education programs should consider developing regular lecture-seminar series for regional earth science teachers, and also offer earth science training designed specifically for current earth science teachers.

3. Future evaluations of earth science resources in states similar to North Dakota should not deal with resources specifically obtained for earth science, but with resources which can be used in teaching earth science, and with how these potential resources are being utilized.

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APPENDIX I QUESTIONAIRE - SCHOOL SURVEY

A. Earth Science Teacher

1. Number of hours spent in classroom

   35 or more
   30-35
   25-30
   25 or under

2. Number of class preparations per day

   6 or more
   5
   4
   3
   2 or less

3. Hours in nonteaching duties per week

   6 or more
   4-6
   2-4
   2 or less

4. Number of quarter hours in geology

   less than 5
   5-10
   10-15
   15 or more

5. Number of quarter hours in astronomy

   less than 4
   4-8
   8-10
   11 or more

6. Number of quarter hours in climatology and meteorology

   less than 4
   4-7
   8-10
   11 or more

7. Number of quarter hours in Oceanography

   less than 4
   4-7
   8-10
   11 or more

8. Number of quarter hours in chemistry

less than 5
5-10
11-15
more than 15

9. Number of quarter hours in physi s

less than 4
4-7
8-10
11 or more

10. Number of quarter hours in biology

less than 5
5-10
11-15
more than 15

B. School Library
*Number of volumes in earth science subjects

Volumes

0-10
10-20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
90-100
100 +

*C. Budgets 1969-70

1. Permanent lab equipment

less than $25
$25-$75
$76-$150
more than $150

2. Expendable lab equipment

less than $25
$25-$50
$50-$75
$75-$100
$100 +

3. Miscellaneous expenses (field trips, etc.)

less than $15
$16-$30
$31-$50
more than $50

*D. Policy toward field trips

easily arranged
can be arranged with difficulty
school will not permit

*E. Classroom facilities

1. Scheduling

room primarily devoted to earth science
room devoted to science
room shared with non-science classes but with lab facilities
non-lab room

*2. Facilities available: add one point for each facility

a. teacher demonstration table _____
i running water _____
ii electricity _____
b. student lab tables _____
i running water _____
ii electricity _____
c. screen for films _____
d. slide projector _____
e. filmstrip projector _____
f. movie projector _____
g. access to films and filmstrips _____

*F. Lab equipment available: add one point for each item

a. topographic maps _____
b. labeled minerals (or identified) _____
c. labeled rocks (or identified) _____
d. labeled fossils (or identified) _____
e. stream table _____
f. weather maps _____
g. barometer _____
h. hydrometer _____
i. telescope _____
j. sky charts or celestrial globe _____
k. demonstration size maps or globe _____
l. streak plates _____
m. geologic models _____
n. planetarium _____
o. hand lenses or low power microscope _____

*G. Class Sizes

less than 25
26-30
31-35
36 or more

*H. Attitude of superintendent toward hiring earth science teacher or scheduling earth science teacher.

Earth Science is a discipline worthy of a teacher as qualified as for any other discipline.

Will give assignment of best qualified person, however, will use it as catchall course if lacks qualified person.

Earth Science is a catchall class anyone can teach.

APPENDIX II SCHOOL PARTICIPATION

Following are tables showing participation in the Resource Center by the various schools in the Minot State College service region. Table I shows participation by schools with over one hundred secondary students. These schools are in general accredited high school districts. Table II shows participation by schools with fewer than one hundred secondary students. These include a number of non-accredited high schools. Table 3 shows participation by urban elementary schools while Table 4 shows participation by rural elementary schools. Not included in any table are those schools where no contact was made. The following key should be used in Tables 1-4.

Physical Resources

a) specific earth science facilities available

b) science facilities available and being used in earth science

c) science facilities available but not being used for earth science, or no science facilities at all

Teacher Preparation

a) earth science teacher has eighteen or more hours earth science

b) has fewer than eighteen hours earth science, but has strong earth science background

c) has fewer than eighteen hours earth science, and less than eighteen hours in other sciences.

Expression of Interest

(Initital expression of interest in the resource center was made in the following manner)

o - oral expression during personnal visit of project director to school

w - written reply to mailings from college

p - participant at resource center function as result of mailings from college

Workshop Participation

yes - teacher from school attended a resource center workshop

Loan Program

1. School borrowed items more than three times
2. School borrowed items three or fewer times
3. School expressed interest, but did not borrow items

Exchange Center

a) actual trade was made

Visiting Lecture Series Attendance

yes - one or more earth science teacher(s) from school attended lecture series

In-service Program Participation

P - one or more teacher(s) participated in an in-service program offered by Minot State College

NP - one or more teacher(s) have expressed interest in being in an in-service program next year

* - one or more teacher(s) participated in summer or in-service programs offered by institutions other than Minot State College

Teacher Aide Program

rn - requested a teacher aide, but request was not honored

rv - request teacher aides and request was honored

Field Trip Program

ft - three or more known field trips

f - one or two known field trips

Other Contact

1. Assisted in setting up senior high geology course
2. Offered extension course at school
3. Assisted an earth science teacher in entering graduate schools
4. More than one teacher in this school participated in resource center activities
5. Provided judges for science fairs

TABLE I. PARTICIPATION SUMMARY IN RESOURCE CENTER BY SCHOOLS WITH OVER 100 SECONDARY SCHOOL STUDENTS

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
1	a	a	owp	yes	3				NP	f	
2	b	a	owp		1	a	yes		P	ft	5
3	a	b	ow								
4	a	b	o						NP	f	
5			o		2				P		
6	b	b	owp	yes					NP	f	
7	b	b	owp		2				NP	f	4
8			o						P	f	
9	b	c	owp		2	a	yes		P	ft	4
10	a	b	owp		1	a	yes		P	ft	2,4
11	a	b	ow		2	a	yes		P	ft	3,4
12	b	b	ow							ft	
13	a	b	wp	yes		a			P*	ft	4
14	c	b	owp			b			P NP		4

TABLE I. (continued)

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
15	a	a	owp	yes	1	a	yes	rv	P NP	ft	4
16	a	a	owp	yes	1	a	yes	rv	P	ft	4
17	a	a	owp	yes	1	a	yes	rn	P	ft	4
18	a	a	owp	yes	1	a	yes	rv	NP P	ft	4
19	b	b	o								
20	b	a	op	yes	1		yes		*	ft	
21	b	a	owp		1	a	yes	rn	P	ft	
22	c	c	o						NP		
23	b	b	owp		1	a	yes	rv	P	ft	6
24	c	b	o						NP		
25	b	b	owp		1			rv		ft	
26	b	b	ow						NP		
27	b	b	w				yes				
28	b	b	op		3		yes				

TABLE I. (continued)

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
29	b	b	w								5
30	b	b	w	yes		a			NP		
31	b	a	owp	yes	1	a	yes	rv	P	ft	
32	c	b	o	yes							
33	a	a	owp		1	a	yes		P	ft	
34	b	b	o								

TABLE 2. PARTICIPATION SUMMARY FOR SCHOOLS WITH FEWER THAN 100 STUDENTS IN SECONDARY SCHOOL

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
1	c				3						
2	c	b	owp	yes	2		yes	rn	P NP	f	4
3		b	o	yes							
4	b	b	ow				yes				
5	c	c	o	yes	2				P	f	
6	b	b	owp		2		yes	rn		f	
7	b	b	o		2		yes			f	
8	c	c	o		2				P		
9	b	c	w						NP		
10	c	c	owp	yes	2		yes	rv	NP	f	4
11	b	c	o		2				NP		
12	c	b	o							f	
13	b	c	o							f	
14			(no)								
15			(no)								

TABLE 2. (continued)

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
16	b	b	owp					rv			1
17	b	a	owp		1	a	yes		P	ft	
18	b	a	owp		1	a	yes		P	ft	
19		b	w	yes						f	
20	b	b	owp	yes	1	a	yes		P* NP	ft	4
21	c	c	w						NP		
22	a	a	owp		1	a	yes	rn	P	ft	
23			w						NP		
24				yes							
25	c		w						NP		
26	b	b	owp				yes	rn	NP	ft	
27	c	c	owp	yes		a				ft	
28	b	b	owp		1	a	yes			ft	

TABLE 2. (continued)

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
29	a	a	owp	yes					NP	ft	
30	a	b	owp	yes	1					ft	
31	a	a	op		2	a	yes			ft	

TABLE 3. PARTICIPATION BY URBAN ELEMENTARY SCHOOLS

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
1	b	c	owp	yes	1			rv		ft	4
2	b	c	owp	yes	1			rv			
3	c	c	w						NP		
4	c	b	owp	yes	1	a	yes	rn	P	ft	5

TABLE 4. PARTICIPATION BY RURAL ELEMENTARY SCHOOLS

Code	Physical Resources	Teacher Prep.	Expressed Interest in Resource Center	Work-shop Part.	Loan Prog.	Exchange Center	Visit-ing Lect. Series	Teacher Aide Program	In-service Prog.	Field-Trip Prog.	Other Contact
1	c	c	o	yes							
2	c	c	o	yes							
3	c	c	owp	yes	1						
4	c	c	owp	yes	1		yes	rn			
5	c	c	owp	yes	1						
6	c	c	owp	yes	1						

APPENDIX III SCHOOL DISTRICTS CONTACT WITH EARTH SCIENCE RESOURCE CENTER 1970-1971

The following list includes all school districts and schools in the Minot State College service region where contacts were made with the Minot State College Earth Science Resource Center during the 1970-1971 academic year. All are in North Dakota.

1. Alsen Public School, Alsen
2. Anamoose Public School, Anamoose
3. Antler Public School, Antler
4. Balfour Public School, Balfour
5. Balta Public School, Balta
6. Berthold Public School, Berthold
7. Bottineau Public Schools, Bottineau

   Bottineau County Schools
   8. Gardena Public School, Gardena
   9. Kramer Public School, Kramer
10. Cando Public Schools, Cando
11. Carpio Public Schools, Carpio
12. Carrington Public Schools, Carrington
13. Cathy Public School, Cathy
14. Crary Public School, Crary
15. Deering Public School, Deering
16. Des Lacs Public School, Des Lacs
17. Devils Lake Public Schools, Devils Lake
18. Donnybrook Public School, Donnybrook
19. Drake Public School, Drake
20. Dunseith Public School, Dunseith
21. Epping Public School, Epping
22. Esmond Public School, Esmond
23. Fessenden Public School, Fessenden

    Foster County Schools
    24. Glenfield Sutton Public Schools, Glenfield
    25. Grace City Public Schools, Grace City
26. Garrison Public School, Garrison
27. Glenburn Public School, Glenburn
28. Granville Public School, Granville
29. Harvey Public Schools, Harvey
30. Hurdsfield Public School, Hurdsfield
31. Kenmare Public Schools, Kenmare
32. Leeds Public School, Leeds
33. Makoti Public School, Makoti
34. Maddock Public School, Maddock
35. Mandan Public Schools, Mandan
36. Maxbass Public School, Maxbass
37. McClusky Public School, McClusky
38. Minnewauken Public School, Minnewauken

    Minot Parochial Schools
    39. Bishop Ryan High School, Minot
    40. St. Leo's School, Minot
    41. St. Anne's School, Belcourt

Minot Public Schools, Minot
42. Erik Ramstad Junior High School
43. Jim Hill Junior High School
44. Memorial Junior High School
45. Minot Senior High School
46. North Hill Elementary School
47. Sunnyside Elementary School
48. Mohall Public School, Mohall
49. Newtown Public School, Newtown
50. Parshall Public School, Parshall
51. Ray Public School, Ray
52. Riverdale Public School, Riverdale
53. Rugby Parochial Schools (Little Flower School), Rugby
54. Rugby Public School, Rugby
55. St. John Public School, St. John
56. Sawyer Public School, Sawyer
57. Sheyenne River Academy, Sheyenne
58. Souris Public School, Souris
59. Stanley Public Schools, Stanley
60. Starkweather Public School, Starkweather
61. Surrey Public School, Surrey
62. Tioga Public Schools, Tioga
63. Towner Public School, Towner
64. Turtle Lake Public School, Turtle Lake
65. Turtle Mountain School, Belcourt
66. Underwood Public School, Underwood
67. Upham Public School, Upham
68. Velva Public School, Velva
Ward County Rural Schools
69. Harrison-Burts School, rural Minot
70. Nedrose School, rural Minot
71. Bell School, rural Minot
72. South Prairie School, rural Minot
73. Westhope Public School, Westhope
74. White Shield High School, Roseglen
75. Willow City Public School, Willow City
76. Wing Public School, Wing
77. Williston Public Schools, Williston